Report Date: 30 Jun 2014

Summary Report for Individual Task
551-88L-3063
Troubleshoot an Electric Motor
Status: Approved

Condition: Given an electric motor aboard a vessel, at sea, at anchor or moored alongside a pier, day or night, under all sea and weather conditions, while wearing the appropriate PPE, (i.e. hearing protection, Nitrile gloves, eye protection, etc.), lock out tag out kit and a marine rail tool box.

Standard: The Soldier correctly conducts troubleshooting procedures pertaining to an electric motor aboard an Army vessel, IAW the appropriate technical manuals, without injury to self or others and without damage to equipment.

Special Condition: None

Safety Risk: Medium

MOPP 4:

Task Statements

Cue: None

DANGER

None

WARNING

None

CAUTION

None

Remarks: None

Notes: None

Performance Steps

CAUTION

Disconnect power to the motor before performing service or maintenance. Discharge all capacitors before servicing motor. Always keep hands and clothing away from moving parts. Be sure required safety guards are in place before starting equipment.

1. Demonstrate troubleshooting procedures for a motor that fails to start upon initial installation, (refer to Figure 551-88L-3063_01).

a. Possible causes:

(1) Motor is wired incorrectly.

(2) Motor is damaged and rotor is striking stator.

(3) Fan guard bent and contacting fan.

b. Actions to take:

(1) Verify the motor is wired correctly.

(2) May be able to reassemble, otherwise motor should be replaced.

(3) Replace the fan guard.

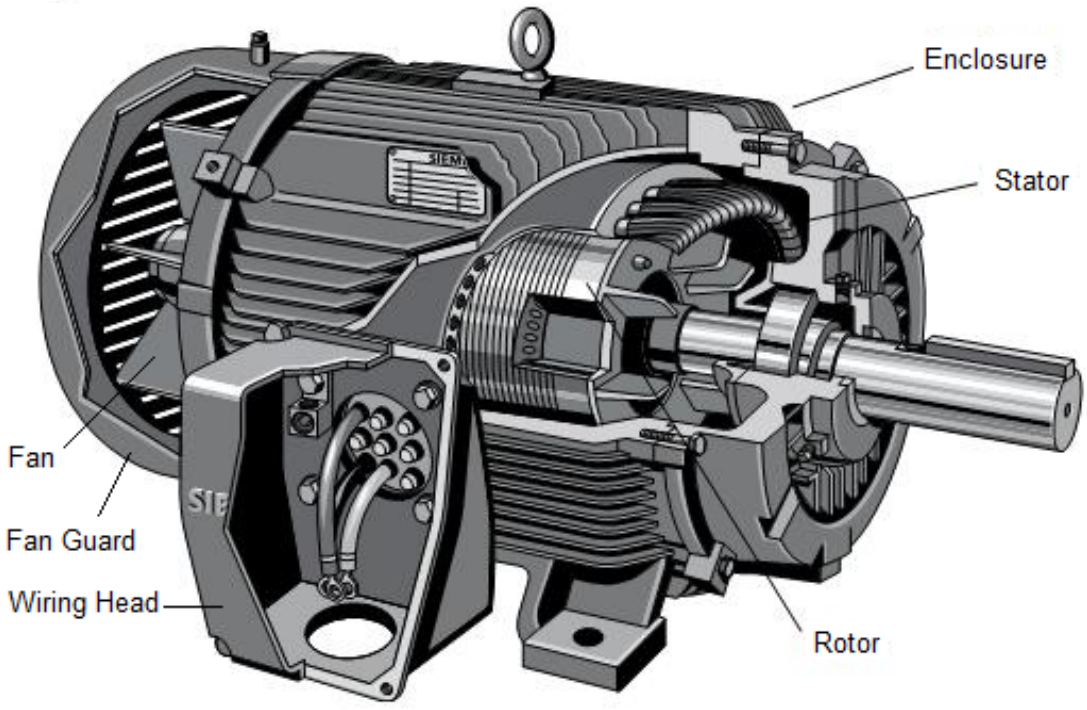

Figure 551-88L-3063_01
Motor components

2. Demonstrate troubleshooting procedures for a motor that has been running and then fails to start.

a. Possible causes:

(1) Fuse or circuit breaker tripped.

(2) Stator is shorted or went to ground.

(a) Motor will make a humming noise.

(b) Circuit breaker will trip.

(3) Motor overloaded or load jammed.

(4) Capacitor (on single phase motor) may have failed, (refer to Figure 55-88L-306_02).

(5) Starting switch has failed.

b. Actions to take:

(1) Replace fuse or reset breaker.

(2) Disassemble motor and inspect windings and internal connections.

(a) A blown stator will show a burn mark.

(b) Motor must be replaced or the stator rewound.

(3) Inspect to see that the load is free. Verify amp draw of motor versus nameplate rating.

(4) First discharge capacitor.

(a) To check capacitor, set volt-ohm meter to RX100 scale and touch its probes to capacitor terminals.

(b) If capacitor is OK, needle will jump to zero ohms, and drift back to high.

(c) Steady ohms indicates a short circuit.

(d) Steady high ohms indicates an open circuit.

(5) Disassemble motor and inspect both the centrifugal and stationary switches.

(a) The weights of the centrifugal switch should move in and out freely.

(b) Make sure that the switch is not loose on the shaft.

(c) Inspect contacts and connections on the stationary switch.

(d) Replace switch if the contacts are burned or pitted.

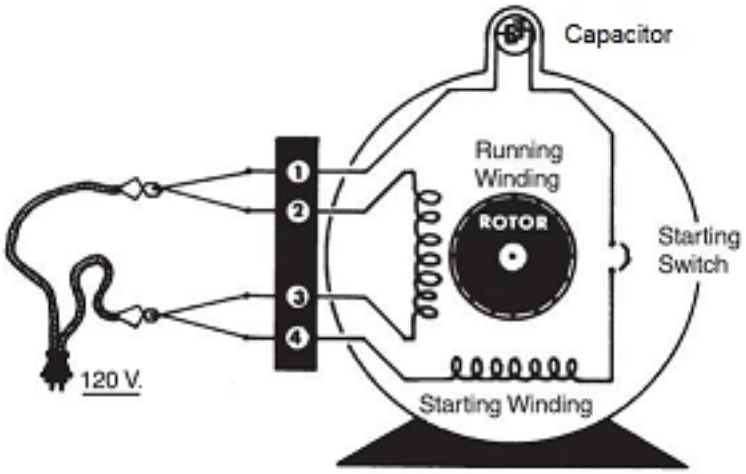

Figure 551-88L-3063_02
Capacitor start motor

3. Demonstrate troubleshooting procedures for a motor that runs but dies down.

a. Possible causes:

(1) Voltage drop.

(2) Load increased.

b. Actions to take:

(1) Make sure switchboard voltage is showing within 10% of the motor’s nameplate rating, if not;

(a) Check shore tie voltage.

(b) Or generator voltage.

(2) Verify the load has not changed.

(a) Verify equipment hasn’t got tighter.

(b) If fan application verify the air flow hasn’t changed.

4. Demonstrate troubleshooting procedures for a motor that takes too long to accelerate.

a. Possible causes:

(1) Defective capacitor.

(2) Faulty stationary switch.

(3) Bad bearings.

(4) Voltage too low.

b. Actions to take:

(1) Test capacitor per step 2.b.4).

(2) Inspect switch contacts and connections. Verify that switch reeds have some spring in them.

(3) Noisy or rough feeling bearings should be replaced.

(4) Make sure switchboard voltage is showing within 10% of the motor's nameplate rating.

(a) If not, check shore tie or generator voltage.

(b) Check if some other equipment is taking power away from the motor.

5. Demonstrate troubleshooting procedures for a motor that runs in the wrong direction, (refer to Figure 551-88L-3063_03).

a. Possible causes; Incorrect wiring.

b. Actions to take; Rewire motor according to wiring schematic provided.

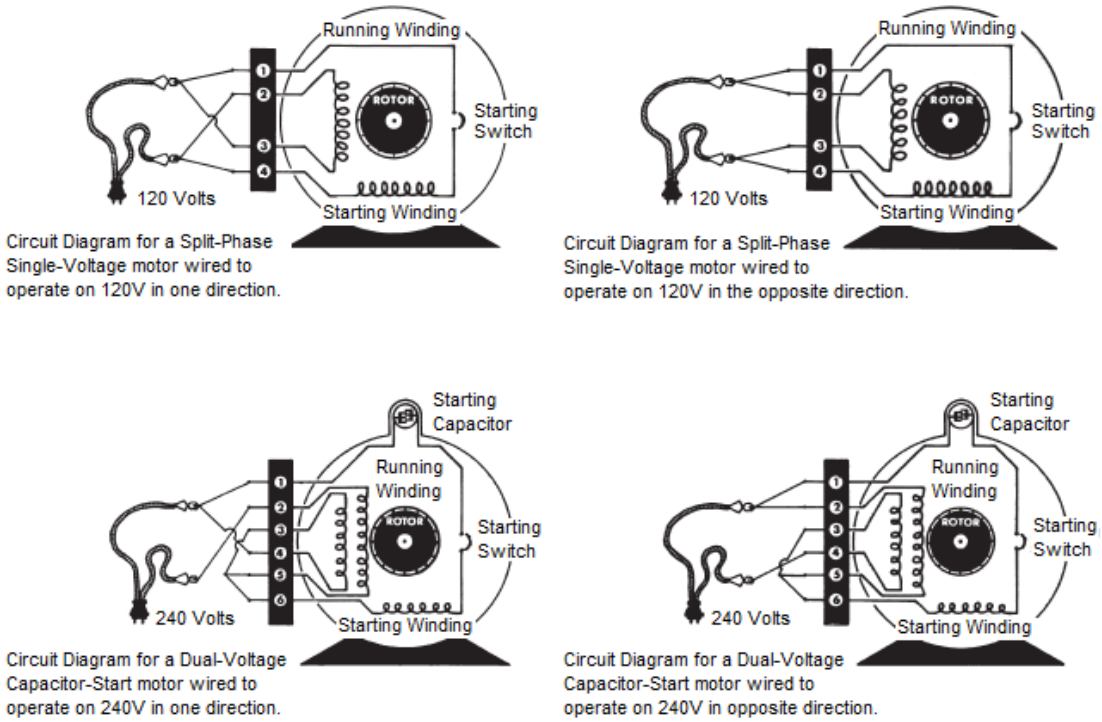

Figure 551-88L-3063_03
Wiring Diagram

6. Demonstrate troubleshooting procedures for a motor that continually trips the overload protector.

a. Possible causes:

(1) Load too high.

(2) Ambient temperature too high.

(3) Protector may be defective.

(4) Winding shorted or grounded.

b. Actions to take:

(1) Verify that the load is not jammed or to high.

(a) If motor is a replacement;

_1_ Verify that the rating is the same as the old motor.

_2_ If previous motor was a special design, a stock motor may not be able to duplicate the performance.

(b) Remove the load from the motor;

_1_ Inspect the amp draw of the motor unloaded, (refer to Figure 551-88L-3063_04).

_2_ Amp draw should be less than the full load rating stamped on the nameplate.
Note: A properly operating motor may be hot to the touch.

(2) Verify that the motor is getting enough air for proper cooling.

(a) Check for blocked air ports.

(b) Most motors are designed to run at an ambient temperature of less than 105° F (40° C).

(3) Replace the motor's protector with a new one of the same rating.

(4) Inspect stator for defects, or loose or cut wires that cause it to go to ground.

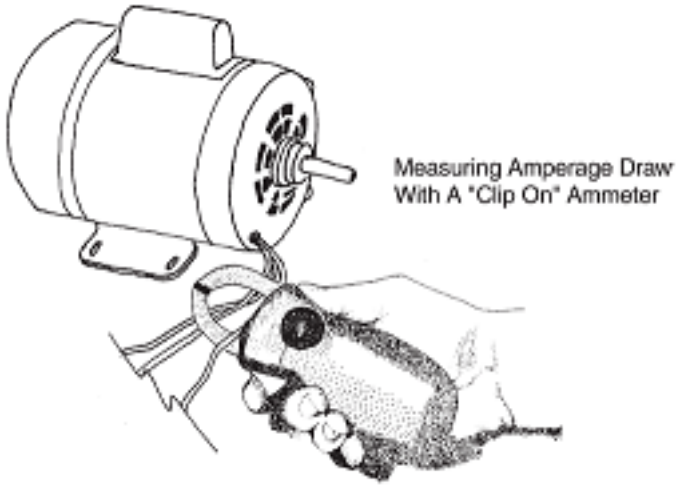

Figure 551-88L-3063_04
Checking AMP draw

7. Demonstrate troubleshooting procedures for a motor that vibrates.

a. Possible causes:

(1) Motor misaligned to load, (refer to Figure 551-88L-3063_05).

(2) Load out of balance, (direct drive application only).

(3) Motor bearings defective.

(4) Rotor out of balance.

(5) Motor may have too much endplay.

(6) Winding may be defective.

b. Actions to take:

(1) Realign load.

(2) Remove motor from load and inspect motor by itself.

(a) Verify that motor shaft is not bent.

(b) Rule of thumb is .001" runout per every inch of shaft length.

(3) Test motor by itself.

(a) If bearings are bad, you will hear noise or feel roughness.

(b) Replace bearings.

(c) Add oil if a sleeve of bearing.

(d) Add grease if bearings have grease fittings.

(4) Inspect motor by itself with no load attached.

(a) If it feels rough and vibrates but the bearings are good, it may be that the rotor was improperly balanced at the factory.

(b) Rotor must be replaced or rebalanced.

(5) With the motor disconnected from power turn the shaft.

(a) It should move but with some resistance.

(b) If the shaft moves in and out too freely, this may indicate a preload problem and the bearings may need additional shimming.

(6) Test winding for shorted or open circuits.

(a) The amps may also be high.

(b) Replace motor or have stator rewound.

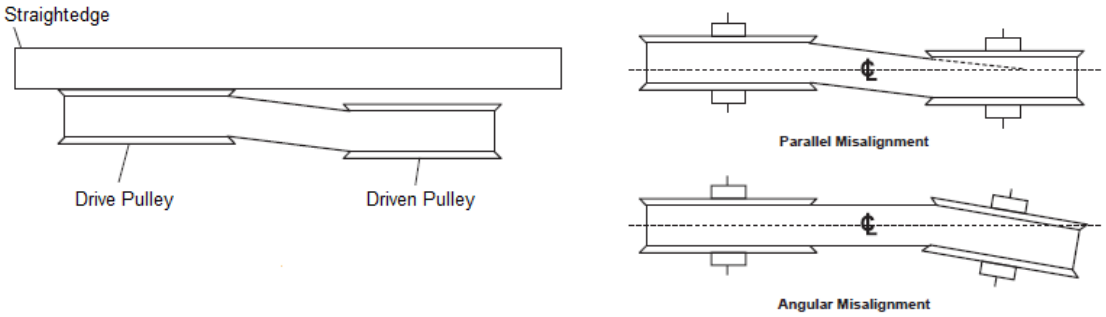

Figure 551-88L-3063_05
Load alignment

8. Demonstrate troubleshooting procedures for a motor that has continuous bearing failures.

a. Possible causes:

(1) Load to motor may be excessive or unbalanced.

(2) High ambient temperature.

b. Actions to take:

(1) Check for motor overload.

(a) Inspect drive belt tension to ensure it's not too tight, (refer to Figure 551-88L-3063_06).

(b) An unbalanced load will also cause the bearings to fail.

(2) If the motor is used in a high ambient temperature, a different type of bearing grease may be required.

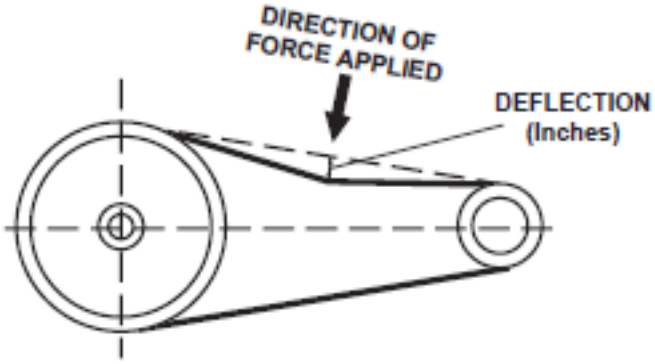

Figure 551-88L-3063_06
Belt tension

9. Demonstrate troubleshooting procedures for a motor that at start up makes a loud rubbing or grinding noise.

a. Possible causes:

(1) Motor may have been damaged during shipment.

(2) Rotor may be striking stator.

(3) Endbells may have been knocked out of alignment during transportation.

b. Actions to take:

(1) Check for damage caused during shipment.

(2) Inspect the motor’s rotor and stator for strike marks, if strike marks are present;

(a) The motor should be replaced.

(b) Sometimes simply disassembling and reassembling motor eliminates rubbing.

(3) Realign the endbells.

10. Demonstrate troubleshooting procedures for a capacitor that continuously fail.

a. Possible causes:

(1) The motor is not coming up to speed quickly enough.

(2) The motor is being cycled too frequently.

(3) Voltage to motor is too low.

(4) Starting switch may be defective, preventing the motor from coming out of start winding.

b. Actions to take:

(1) Motor may not be sized properly.

(a) Verify how long the motor takes to come up to speed.

(b) Most single phase capacitor start motors should come up to speed within three seconds, otherwise the capacitors may fail.

(2) Verify duty cycle.

(a) Capacitor manufacturers recommend no more than 20, three-second starts per hour.

(b) Install capacitor with higher voltage rating, or add bleed resistor to the capacitor.

(3) Verify that voltage to the motor is within 10% of the nameplate value.

(4) Replace switch.

11. Demonstrate troubleshooting procedures for run capacitor failure.

a. Possible causes:

(1) Ambient temperature too high.

(2) Possible power surge to motor, caused by lightning strike or other high transient voltage.

b. Actions to take:

(1) Verify that ambient temperature does not exceed motor’s nameplate value.

(2) If a common problem, install surge protector.

(Asterisks indicates a leader performance step.)

Evaluation Guidance: None

Evaluation Preparation: None

PERFORMANCE MEASURES	GO	NO-GO	N/A
1. Demonstrated troubleshooting procedures for a motor that fails to start upon initial installation.			
a. Motor is wired incorrectly.			
b. Motor is damaged and rotor is striking stator.			
c. Fan guard bent and contacting fan.			
2. Demonstrated troubleshooting procedures for a motor that has been running and then fails to start.			
a. Fuse or circuit breaker tripped.			
b. Stator is shorted or went to ground.			
c. Motor overloaded or load jammed.			
d. Capacitor (on single phase motor) may have failed.			
e. Starting switch has failed.			
3. Demonstrated troubleshooting procedures for a motor that runs but dies down.			
a. Voltage drop.			
b. Load increased.			
4. Demonstrated troubleshooting procedures for a motor that takes too long to accelerate.			
a. Defective capacitor.			
b. Faulty stationary switch.			
c. Bad bearings.			
d. Voltage too low.			
5. Demonstrated troubleshooting procedures for a motor that runs in the wrong direction.			
6. Demonstrated troubleshooting procedures for a motor that continually trips the overload protector.			
a. Load too high.			
b. Ambient temperature too high.			
c. Protector may be defective.			
d. Winding shorted or grounded.			
7. Demonstrated troubleshooting procedures for a motor that vibrates.			
a. Motor misaligned to load.			
b. Load out of balance.			
c. Motor bearings defective.			
d. Rotor out of balance.			
e. Motor may have too much endplay.			
f. Winding may be defective.			
8. Demonstrated troubleshooting procedures for a motor that vibrates.			
a. Load to motor may be excessive or unbalanced.			
b. High ambient temperature.			
9. Demonstrated troubleshooting procedures for a motor that at start up makes a loud rubbing or grinding noise.			
a. Motor damaged.			
b. Rotor may be striking stator.			
c. Endbells out of alignment.			
10. Demonstrated troubleshooting procedures for a capacitor that continuously fail.			
a. The motor is not coming up to speed quickly enough.			
b. The motor is being cycled too frequently.			
c. Low motor voltage.			
d. Defective starting switch.			
11. Demonstrated troubleshooting procedures for run capacitor failure.			
a. Ambient temperature too high.			
b. Possible power surge to motor.			

Supporting Reference(s):

Step Number	Reference ID	Reference Name	Required	Primary
	TC 55-509	MARINE ENGINEMAN's HANDBOOK	No	No
	TC 55-509-1	Marine Electricity	No	No

Environment: Environmental protection is not just the law but the right thing to do. It is a continual process and starts with deliberate planning. Always be alert to ways to protect our environment during training and missions. In doing so, you will contribute to the sustainment of our training resources while protecting people and the environment from harmful effects. Refer to FM 3-34.5 Environmental Considerations and GTA 05-08-002 ENVIRONMENTAL-RELATED RISK ASSESSMENT.

Safety: In a training environment, leaders must perform a risk assessment in accordance with ATP 5-19, Risk Management. Leaders will complete the current Deliberate Risk Assessment Worksheet in accordance with the TRADOC Safety Officer during the planning and completion of each task and sub-task by assessing mission, enemy, terrain and weather, troops and support available-time available and civil considerations, (METT-TC). Note: During MOPP training, leaders must ensure personnel are monitored for potential heat injury. Local policies and procedures must be followed during times of increased heat category in order to avoid heat related injury. Consider the MOPP work/rest cycles and water replacement guidelines IAW FM 3-11.4, Multiservice Tactics, Techniques, and Procedures for Nuclear, Biological, and Chemical (NBC) Protection, FM 3-11.5, Multiservice Tactics, Techniques, and Procedures for Chemical, Biological, Radiological, and Nuclear Decontamination.

Prerequisite Individual Tasks : None

Supporting Individual Tasks :

Task Number	Title	Proponent	Status
551-88L-3052	Trouble Shoot a Hydraulic System	551 - Transportation (Individual)	Approved
551-88L-1037	Demonstrate Basic Knowledge of an Electric Motor	551 - Transportation (Individual)	Analysis
551-88L-2056	Maintain an Electric Motor	551 - Transportation (Individual)	Approved

Supported Individual Tasks :

Task Number	Title	Proponent	Status
551-88L-2056	Maintain an Electric Motor	551 - Transportation (Individual)	Approved
551-88L-1037	Demonstrate Basic Knowledge of an Electric Motor	551 - Transportation (Individual)	Analysis
551-88L-1037	Demonstrate Basic Knowledge of a Electric Motor	551 - Transportation (Individual)	Approved

Supported Collective Tasks : None

ICTL Data :

ICTL Title	Personnel Type	MOS Data
88L40 Watercraft Engineer	Enlisted	MOS: 88L, Skill Level: SL4, Duty Pos: TGB, LIC: EN, SQI: O
88L30 Watercraft Engineer	Enlisted	MOS: 88L, Skill Level: SL3, Duty Pos: TFR, LIC: EN